

Infection of marine phytoplankton by parasitoid protists

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Parasitoid Protists

- infect phytoplankton
- lethal for algal host
- many are nanoflagellates
- various taxonomic groups
- abundant in summer / autumn
(North Sea)

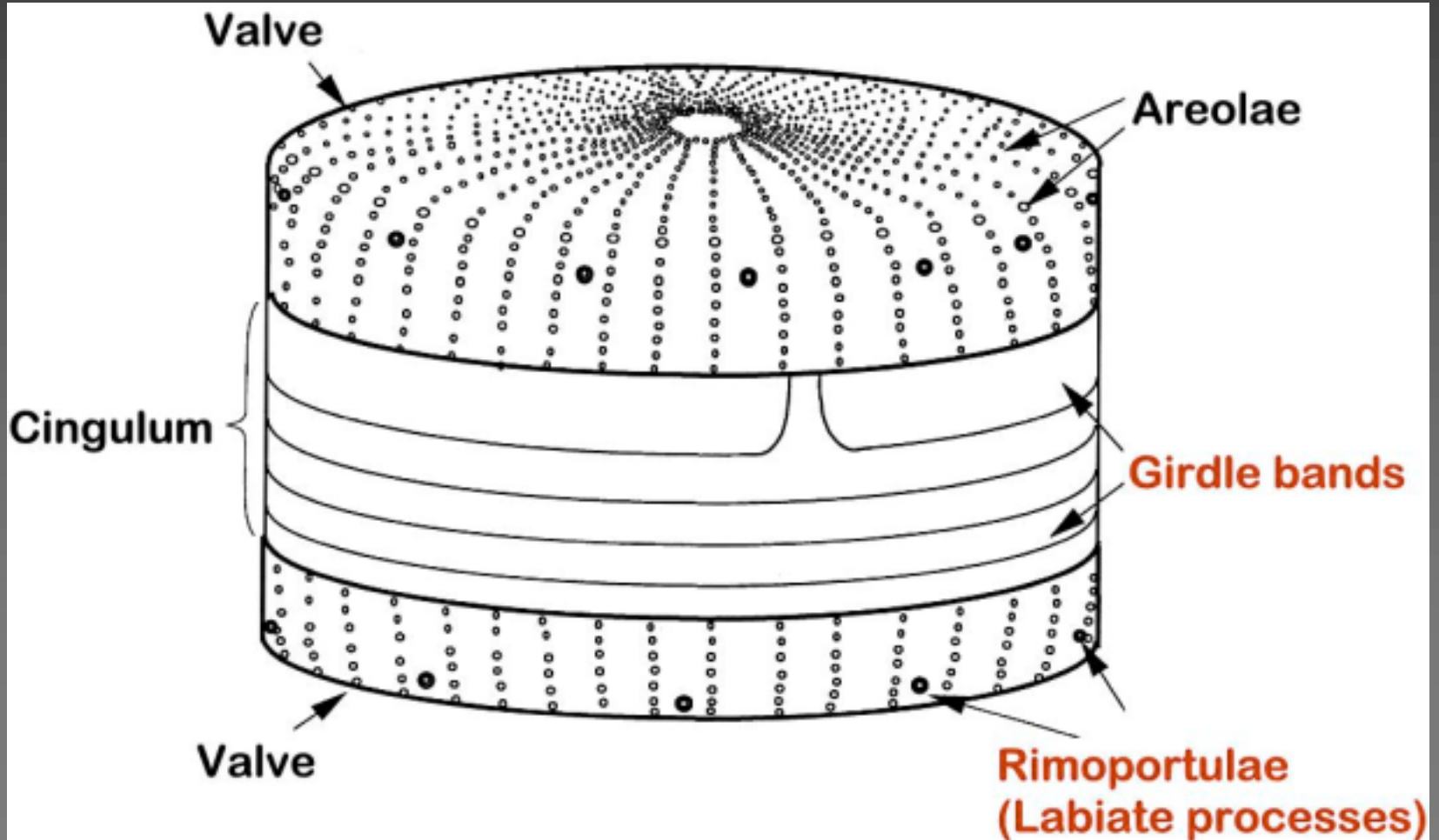
Infected diatoms

Actinocyclus normanii	Ectrogella perforans	Coscinodiscus sp.	Ectrogella perforans
Bacteriastrum hyalinum	Ectrogella sp. Paulsenella sp. Rhizamoeba schnepfii Rhizophydium spp.	Cylindrotheca closterium	Chytrid "B"
Bellerochea malleus	Chytrid "A" Ectrogella perforans Paulsenella vonstoschii Phagomyxa sp. Rhynchopus coscinodiscivorus	Detonula pumila	Ectrogella perforans Pirsonia sp.
Cerataulina bergonii	Cryothecomonas longipes	Eucampia zodiacus	Ectrogella perforans Paulsenella kornmanii Pirsonia eucampia Pirsonia formosa Pirsonia mucosa Pirsonia strain 99-2
Cerataulina pelagica	Cryothecomonas longipes Ectrogella sp. Pirsonia eucampia Pirsonia formosa Pirsonia mucosa	Guinardia delicatula	Cryothecomonas aestivalis 1 Cryothecomonas aestivalis 2 Cryothecomonas longipes Ectrogella perforans Pirsonia formosa Pirsonia guinardiae Pirsonia mucosa Pirsonia verrucosa Pirsonia strain 98 Pirsonia strain 99-1 Pirsonia strain 99-2 Pirsonia strain 99-S Rhizamoeba schnepfii
Chaetoceros borealis	Paulsenella chaetoceratis	G. flaccida	Cryothecomonas aestivalis 2 Pirsonia guinardiae Pirsonia formosa Pirsonia mucosa Pirsonia strain 99-1 Pirsonia strain 99-2 Pirsonia strain 99-S Rhizamoeba schnepfii
C. costatus	Cryothecomonas longipes	G. striata	Pirsonia formosa Cryothecomonas sp.
C. danicus	Ectrogella perforans	Helicotheca tamesis	Chytrid "A" Chytrid Paulsenella vonstoschii
C. debilis	Cryothecomonas longipes	Lauderia annulata	Ectrogella perforans Pirsonia eucampiae Paulsenella sp.
C. densus	Rhizophydium spp.		
C. decipiens	cf. Cryothecomonas longipes Paulsenella chaetoceratis		
C. didymus Ehrenberg	Cryothecomonas longipes Rhizamoeba schnepfii		
Chaetoceros sp.	Phagomyxa sp.		
Coscinodiscus centralis	Lagenidium sp.		
C. concinnus	Hemistasia phaeocysticola Lagenisma coscinodisci Pirsonia diadema Rhynchopus coscinodiscivorus		
C. granii	Cryothecomonas longipes Hemistasia phaeocysticola Lagenisma coscinodiscii Pirsonia diadema		
C. wailesii	Cryothecomonas longipes Hemistasia phaeocysticola Lagenisma coscinodiscii		

Leptocylindrus danicus Cleve	Cryothecomonas longipes Pirsonia eucampiae Pirsonia formosa Pirsonia mucosa Pirsonia strain 99-1 Pirsonia strain 99-2	Skeletonema costatum Stephanopyxis turris	cf. Chytrid "B" Ectrogella perforans Pirsonia formosa Rhizamoeba schneppfii
Licmophora spp.	Ectrogella perforans	Striatella unipunctata Synedra sp.	Ectrogella perforans Ectrogella perforans
Lithodesmium undulatum	Chytrid "A" Ectrogella perforans Paulsenella vonstoschii	Thalassionema nitzschioides	Ectrogella perforans Pirsonia formosa
Navicula sp.	Chytrid "B" Cryothecomonas longipes Ectrogella or Olpidiopsis	Thalassiosira hendeyi T. minima T. cf. pacifica T. punctigera	Pirsonia punctigerae Ectrogella sp. Chytrid sp. Cryothecomonas longipes Ectrogella perforans. Pirsonia punctigerae Pseudaphelidium drebesii
Neostreptothea subindica	Paulsenella vonstoschii	T. rotula Meunier	Chytrid Cryothecomonas longipes Ectrogella perforans. Pirsonia punctigerae cf. ThraustoChytrid
Odontella aurita	Gyrodinium undulans Hemistasia phaeocysticola	Triceratium alternans	Ectrogella sp.
O. sinensis	Amoeba biddulphiae Chytrid "A" Phagomyxa odontellae		
Palmeria hardmaniana	Lagenisma coscinodisci		
Pleurosigma sp.	Cryothecomonas longipes		
Porosira glacialis (Ectrogella sp.		
Pseudo-nitzschia fraudulenta (Olpidium marinum		
P. pungens	Olpidium marinum		
Pseudo-nitzschia sp.	Diplopsalis group cf. Cryothecomonas sp. Olpidium sp. Parapedinella reticulata		
Rhizosolenia imbricata	Pirsonia formosa Pirsonia mucosa Pirsonia strain 99-1 Pirsonia strain 99-2		
Rhizosolenia pungens	Pirsonia formosa		
R. setigera	Pirsonia formosa Pirsonia lenis		
R. similoides	Pirsonia formosa Pirsonia strain 99-2 Pirsonia strain 99-S		

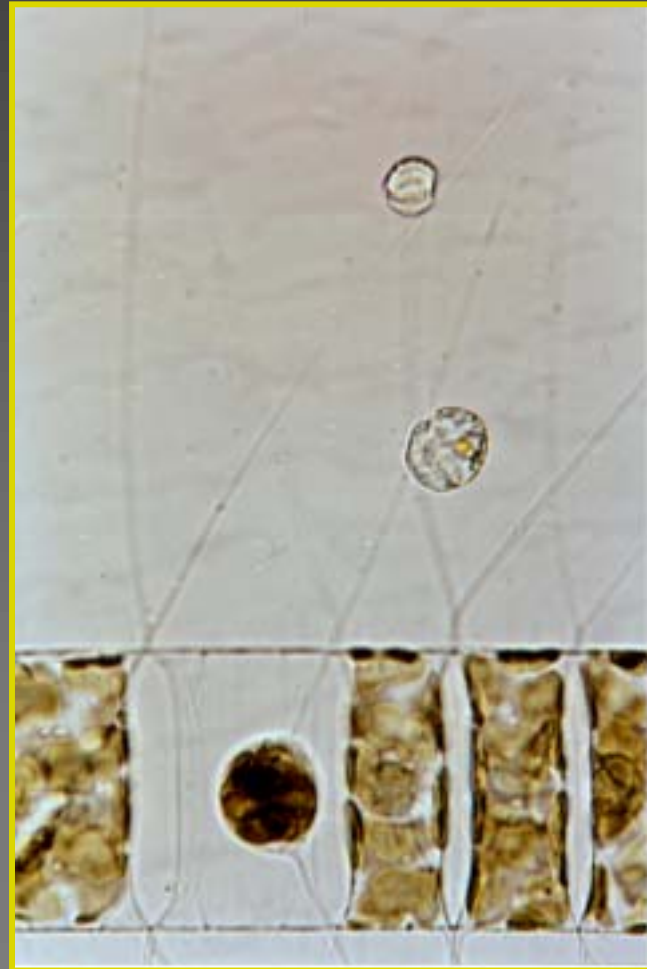
- **53 diatom species**
- **> 20 parasitoid species**

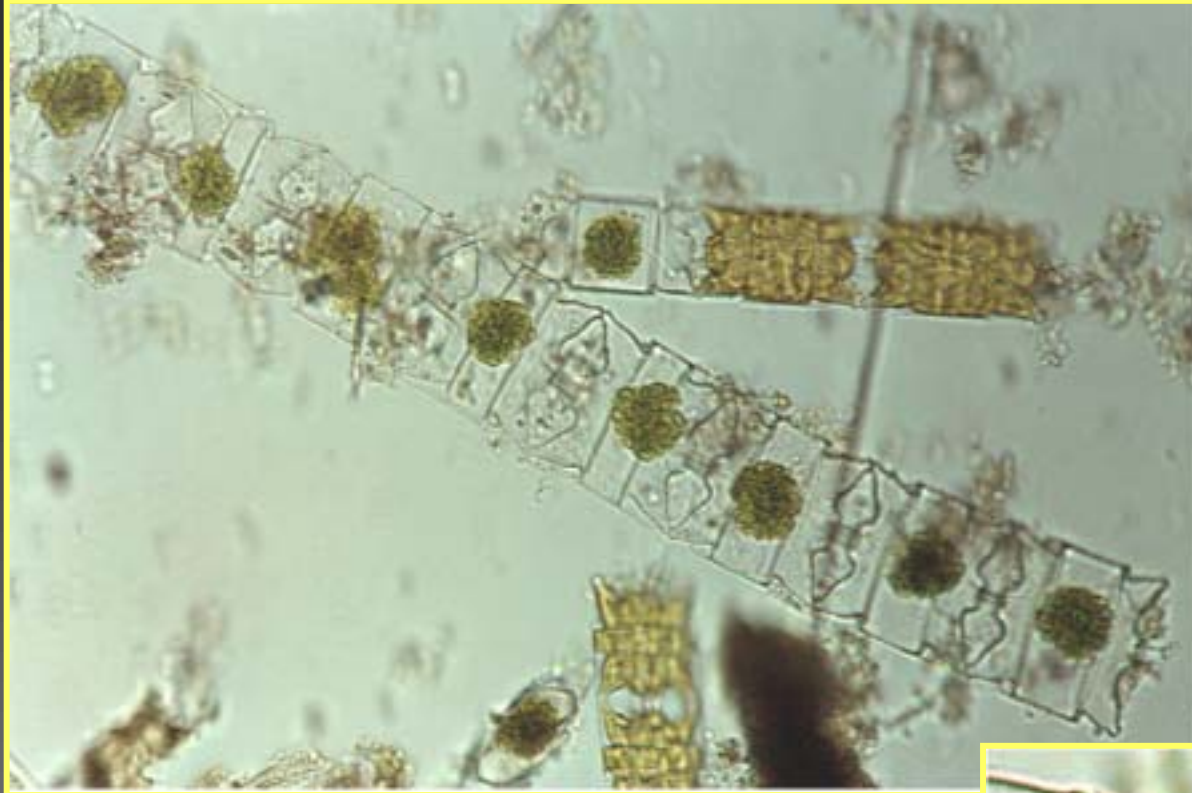
Infection sites



Paulsenella

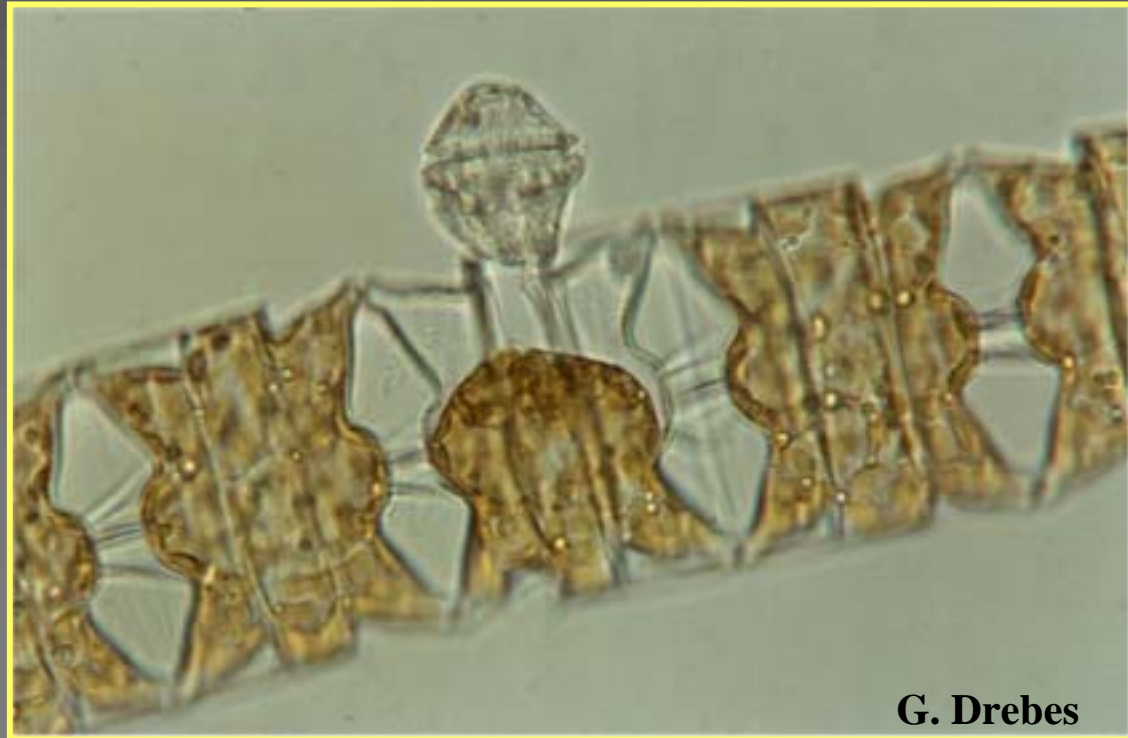
- dinoflagellate
- 3 species
- ✓ in culture (1 species)





Gyrodinium undulans

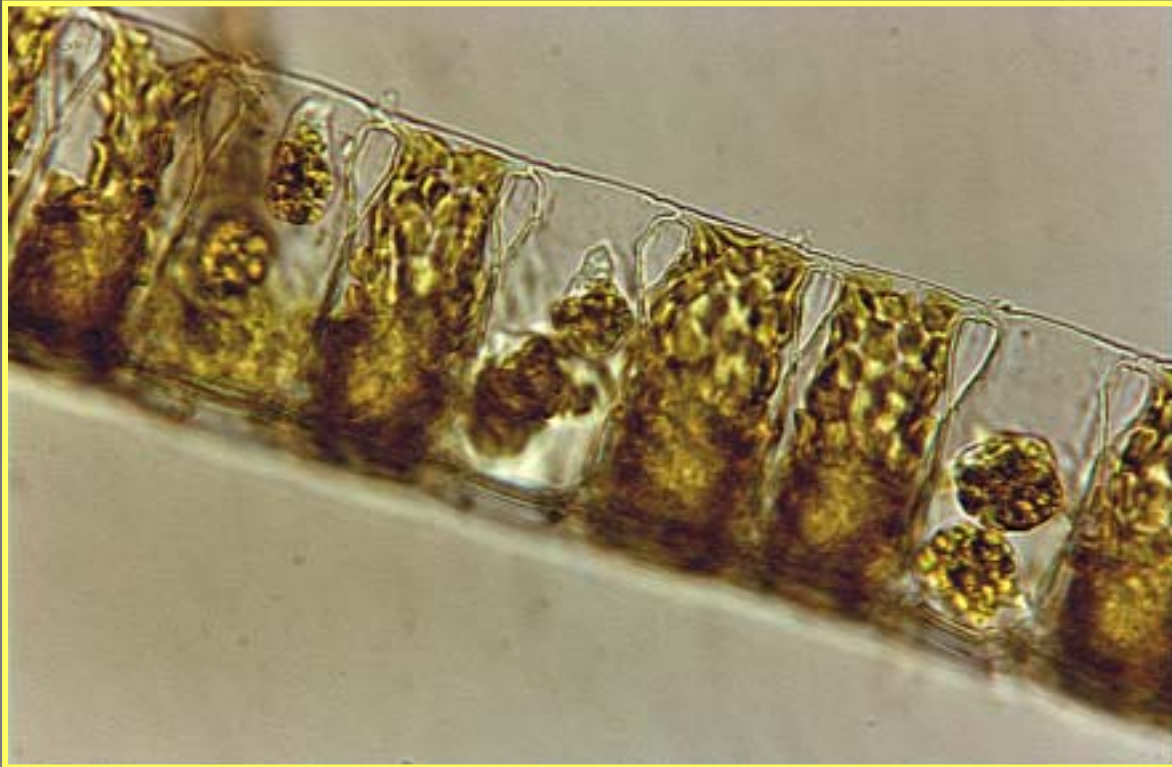
- dinoflagellate
- can be cultivated



G. Drebes

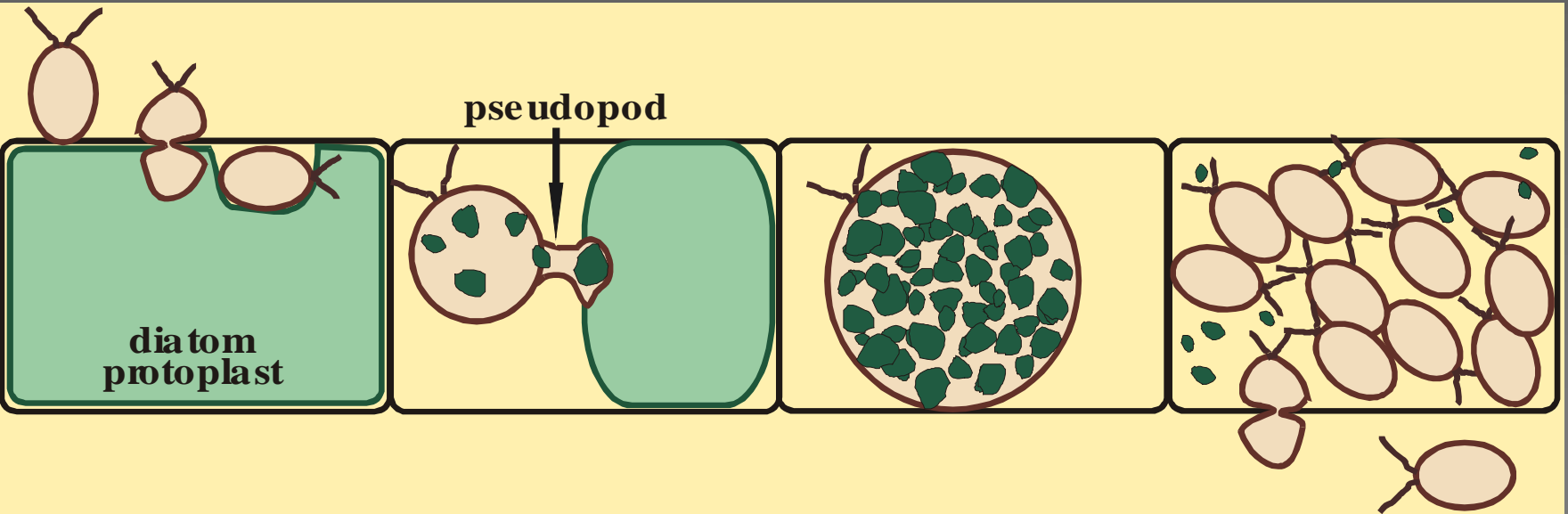
Rhynchosopus sp.

➤ Kinetoplastida



Cryothecomonas

- Cercomonad
- 2 parasitoid species
- ✓ in culture (1 species)

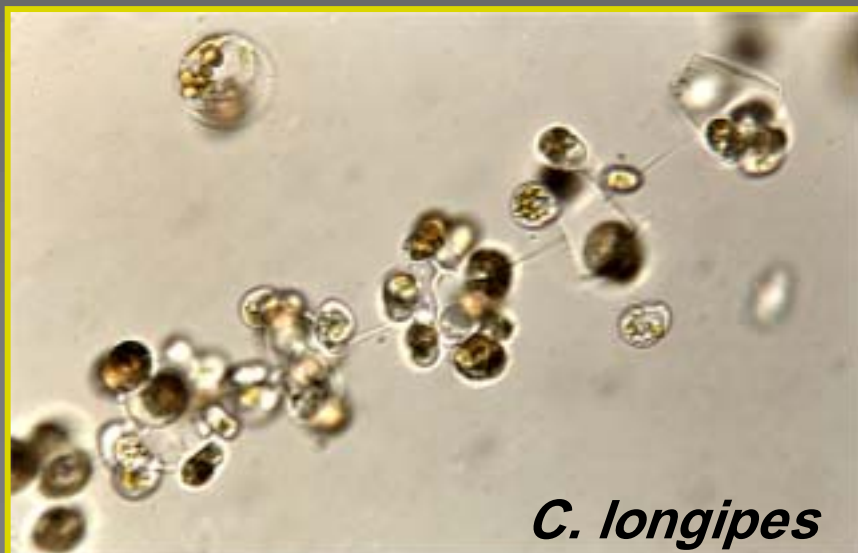




C. aestivalis 1

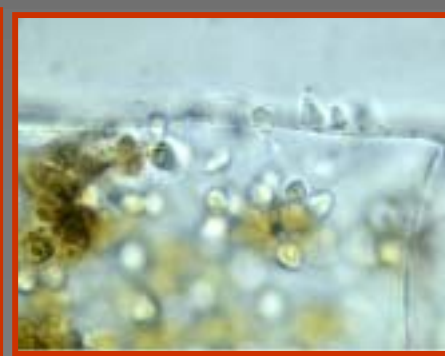


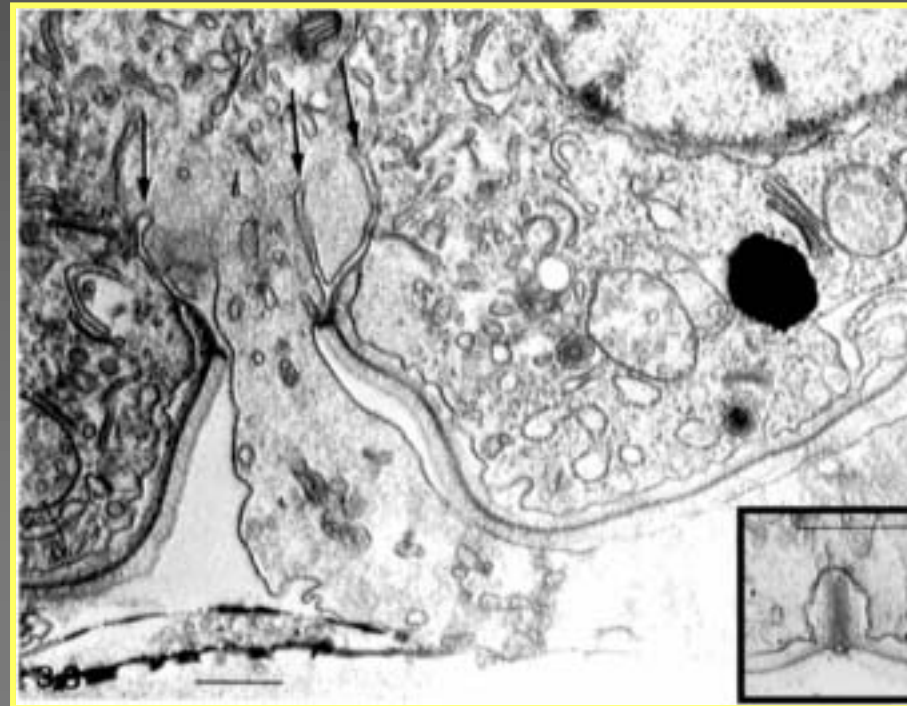
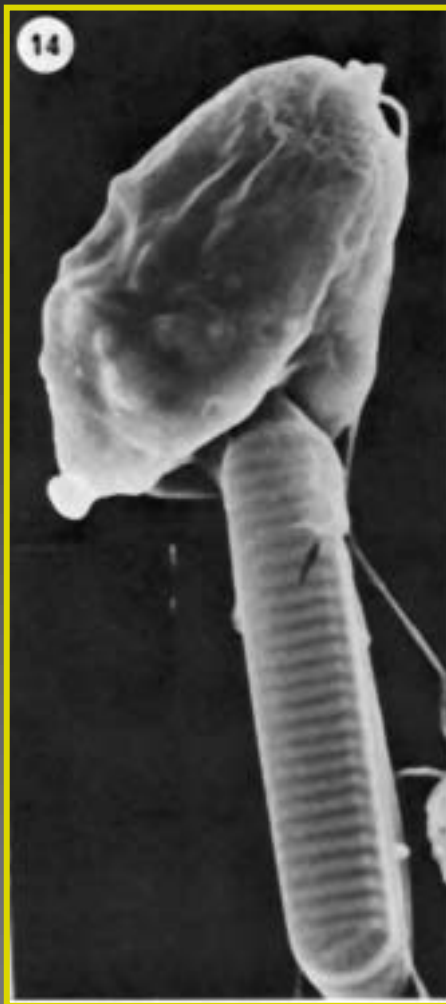
C. aestivalis 2

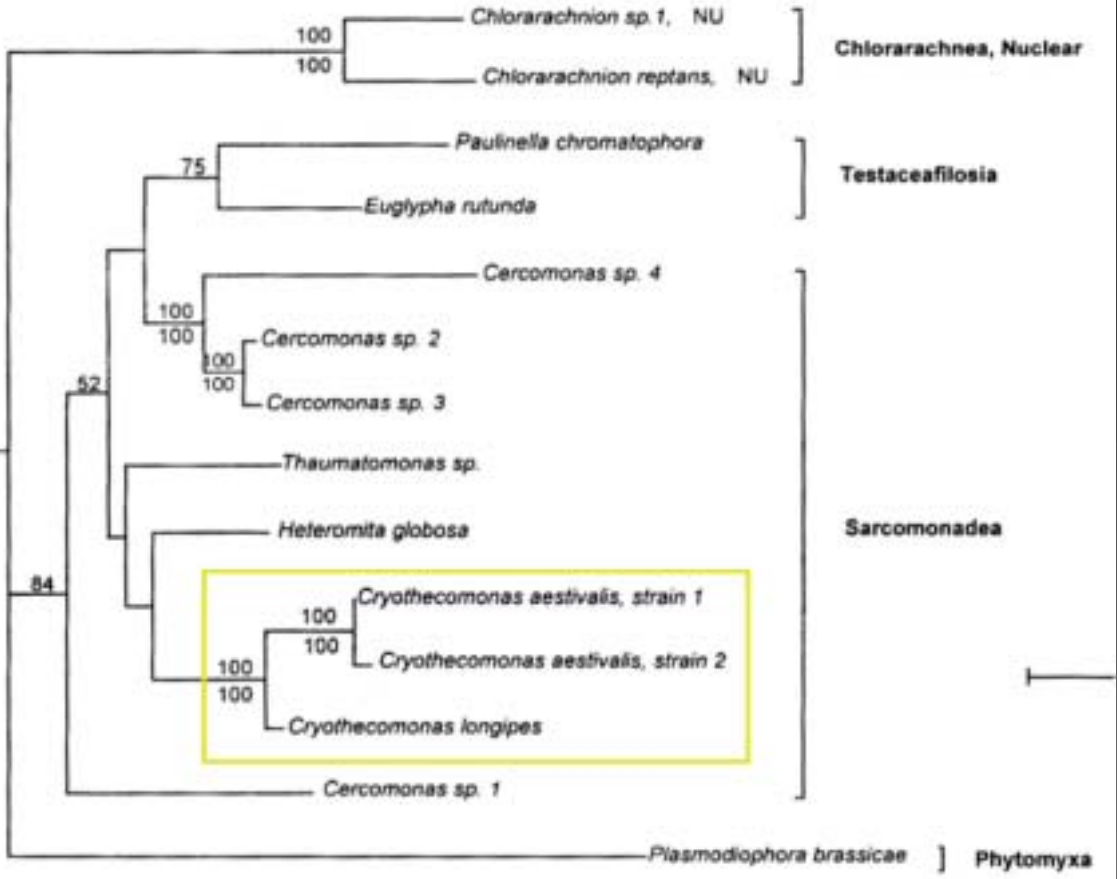


C. longipes

new species or strains?





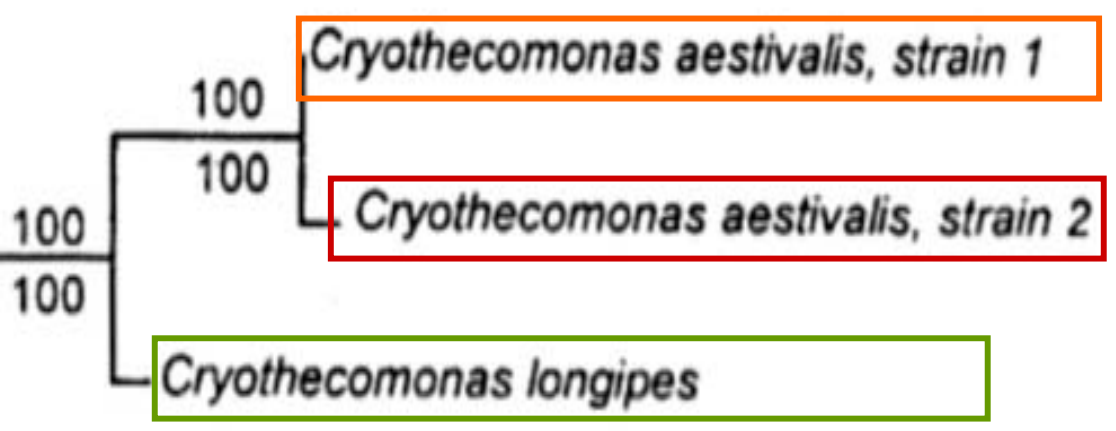


Host diatoms:

Guinardia delicatula
G. flaccida

Guinardia delicatula

many diatoms

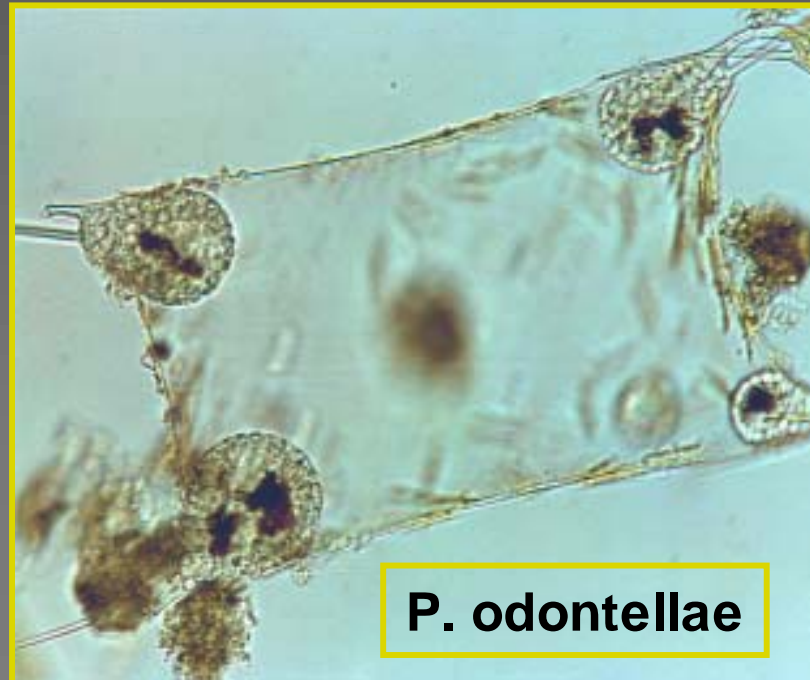


Phagomyxa

➤ Plasmodiophorid

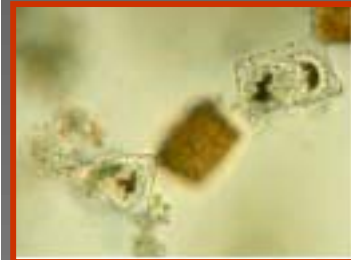
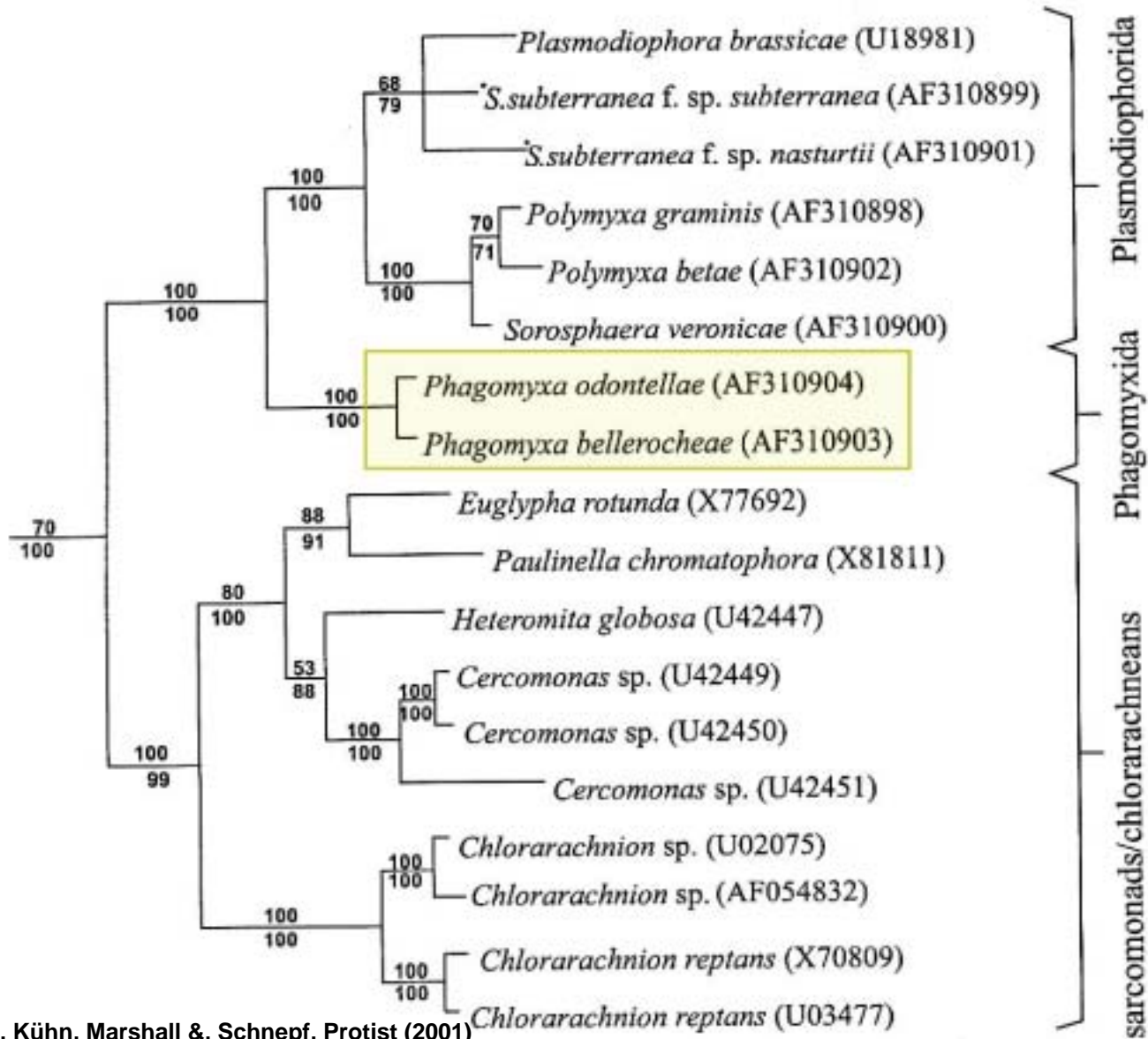


P. bellerocheae

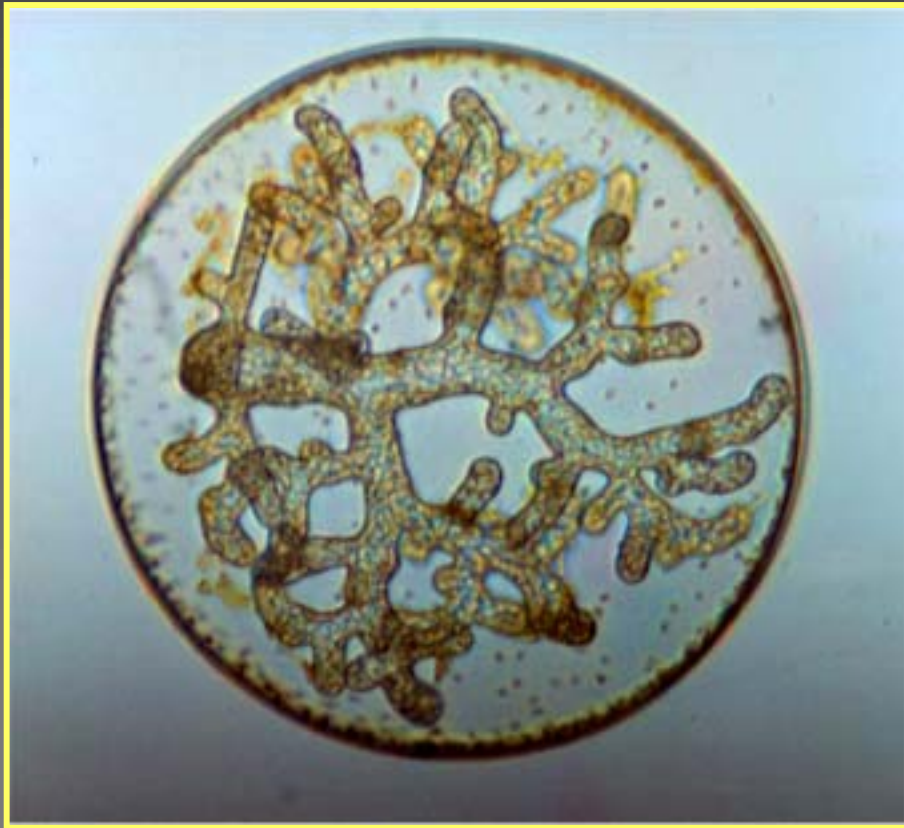


P. odontellae

Phagomyxa



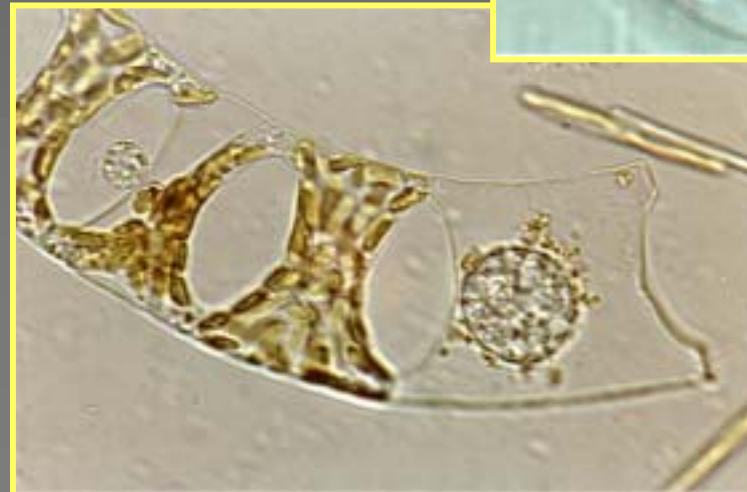
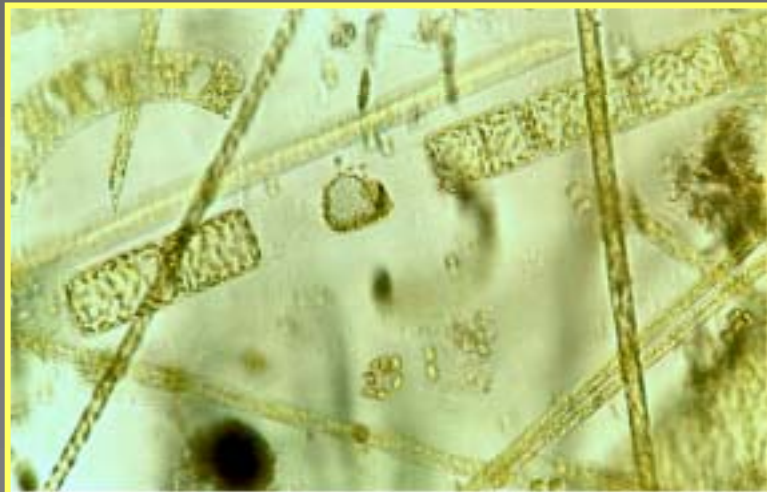
Lagenisma



- Oomycete (Heterokonta)
- can be cultivated

Ectrogella

- Oomycete (Heterokonta)
- ✓ in culture

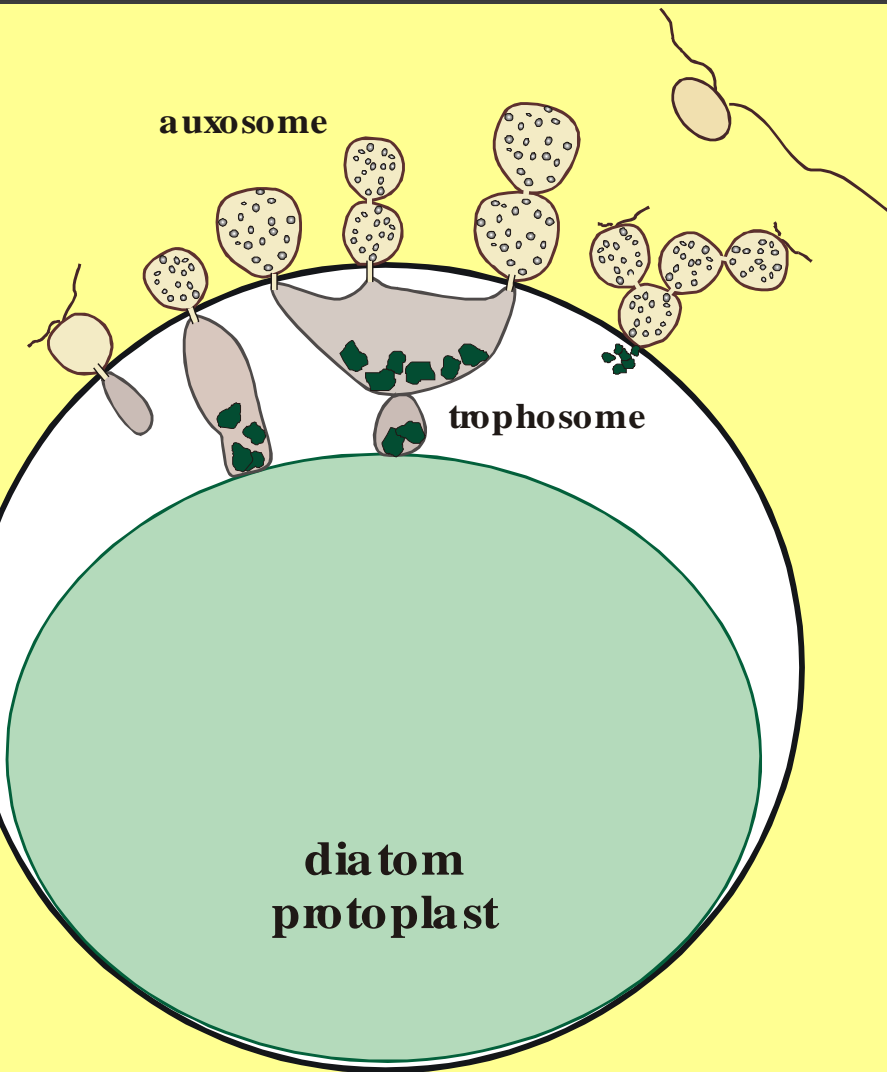


Olpidium sp.

- Oomycete (Heterokonta)



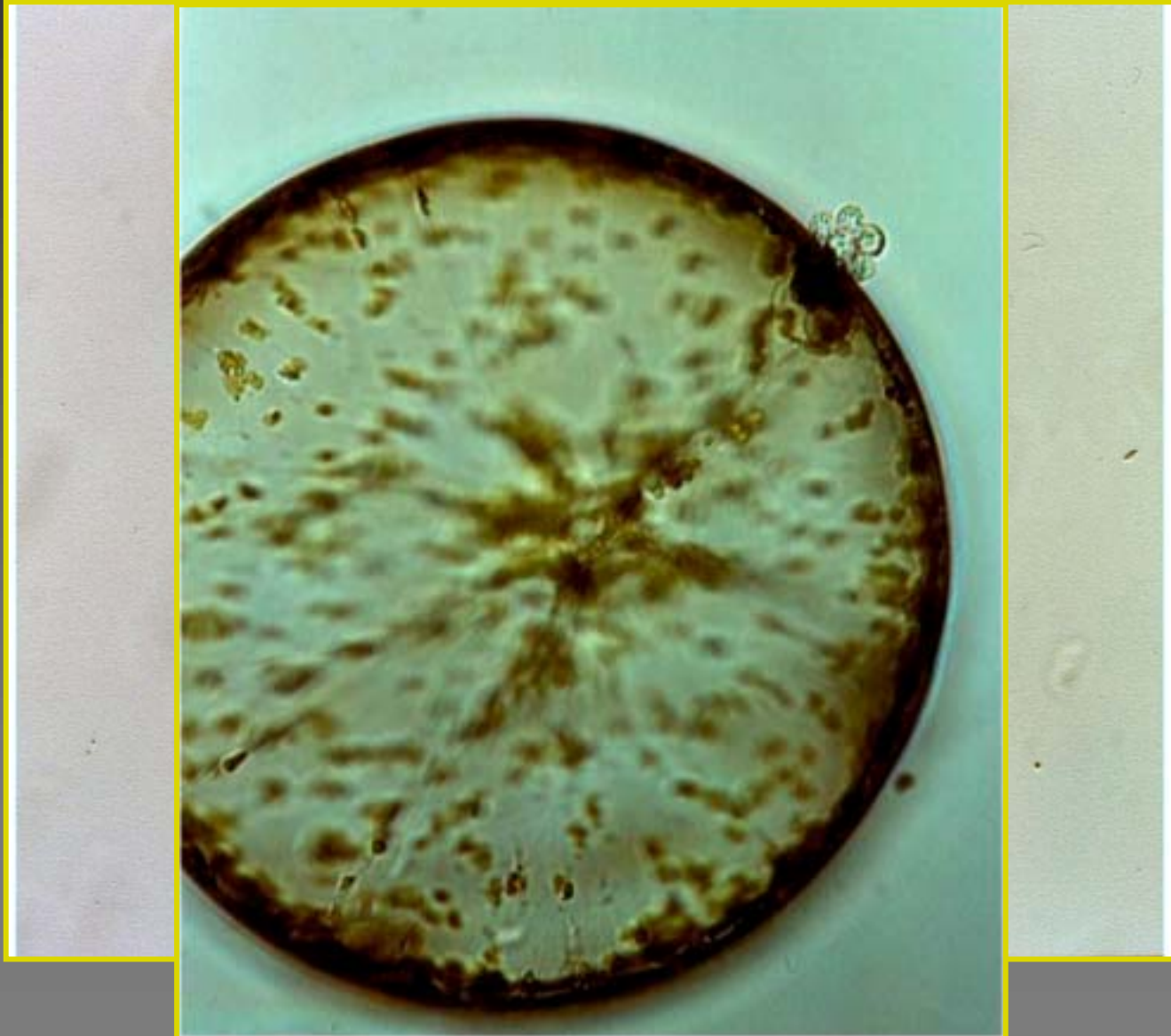
Pirsonia



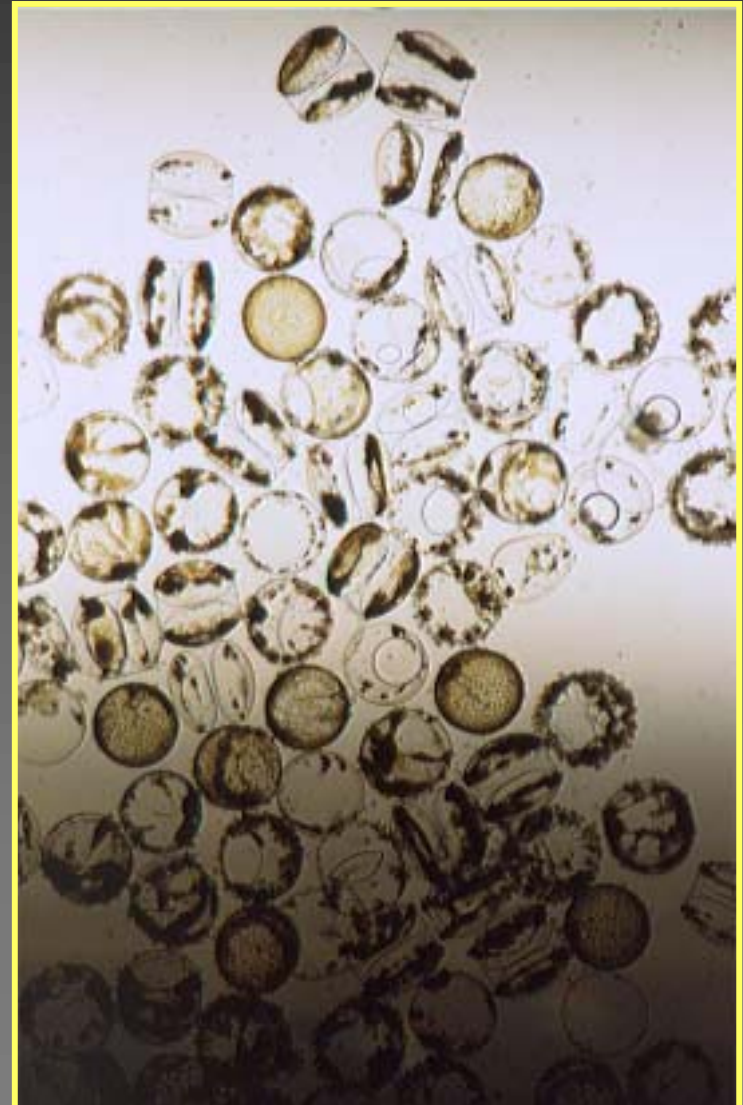
- Stramenopile (Heterokonta (protista incerta sedis))
- 7 species described
- ✓ in culture (2 species)



Pirsonia diadema



selective for hosts



Pirsonia



P. verrucosa



P. guinardiae



P. punctigerae



P. mucosa



„*P. necrophaga*“

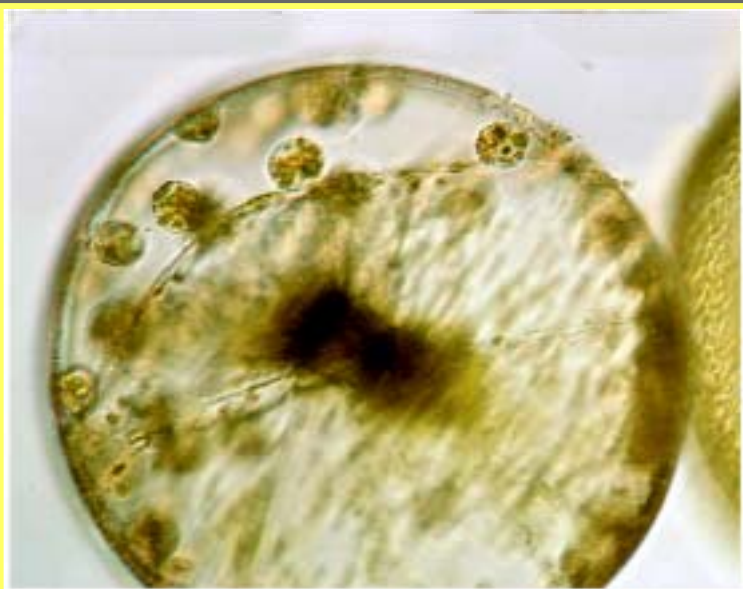
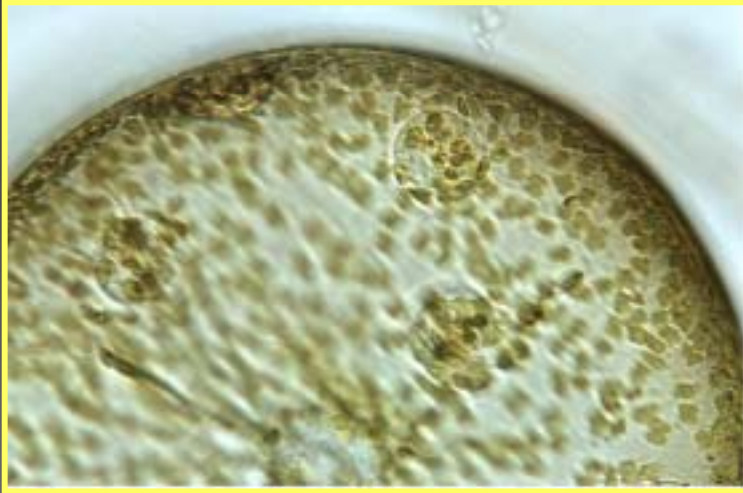
Chytrid



✓ in culture

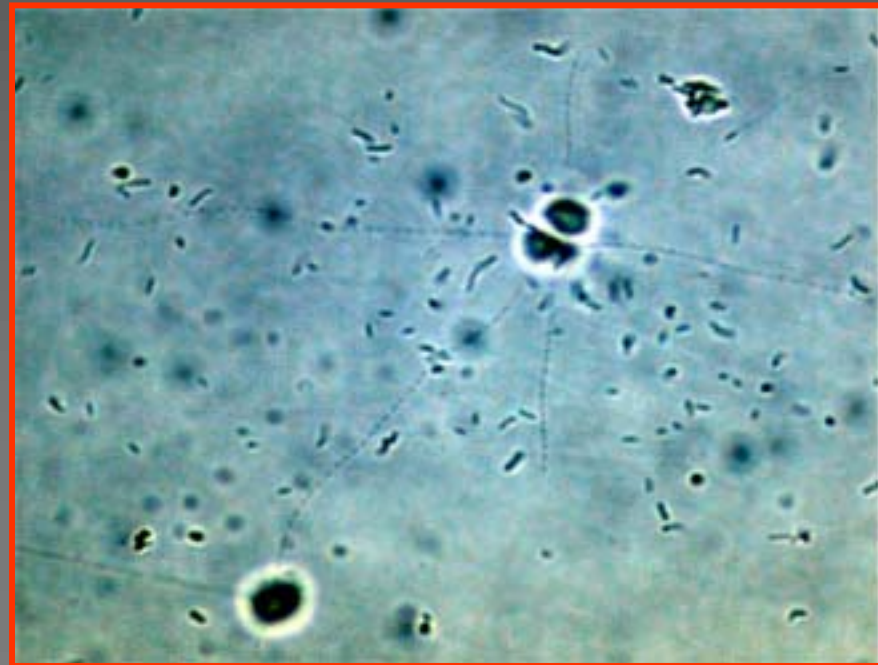
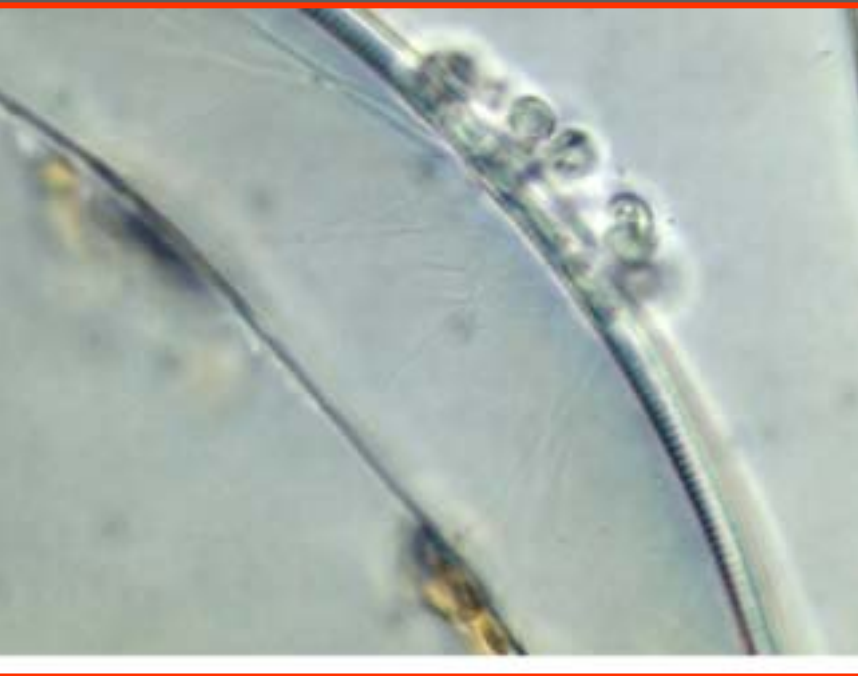
Victoriniella multififormis

➤ protista incerta sedis

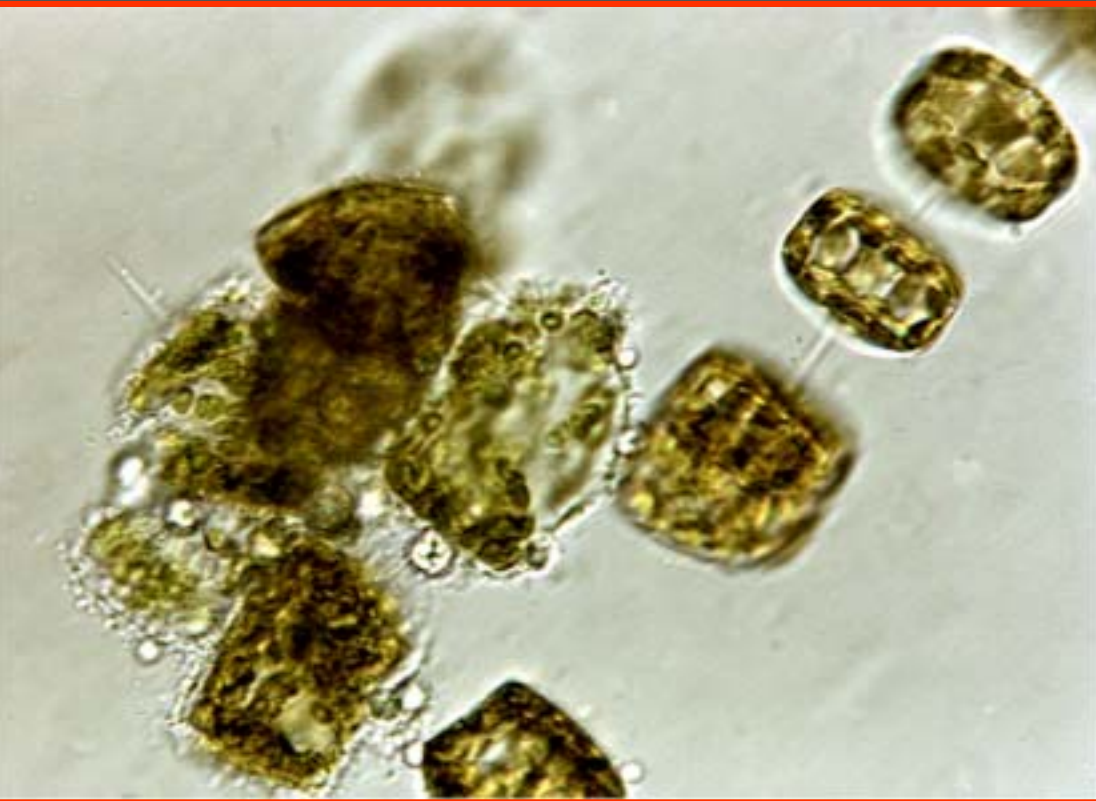


Not identified (A)

✓ in culture



Not identified (B)



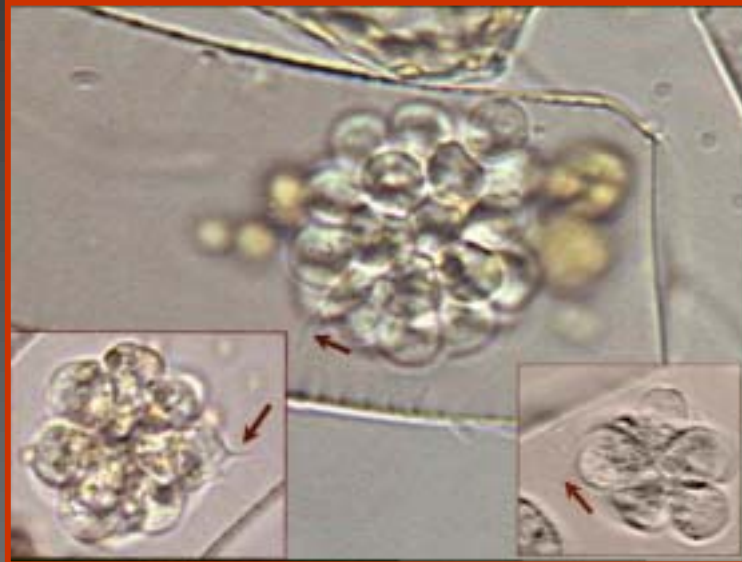
➤ can be cultivated

Not identified (C)



- **can be cultivated**
(for short period)

Not identified (D)



➤ can be cultivated (for short period)



Conclusions

- **most planktonic diatoms (North Sea) get infected**
- **many parasitoids are not yet described**
- **little is known about their autecology, occurrence and abundance**
- **does evolution shape towards host specificity?**